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ing where philosophers now hesitate to tread. I have commented upon their venture in an earlier volume of this JOURNAL.⁴

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MEMORY: A TRIPHASE OBJECTIVE ACTION

DEPLORABLE it is that the commendable enterprise of attempting to study the facts of psychology in an objective manner has not developed without regrettable aspects. To mention only one of the unfortunate conditions, why should it be necessary, in order to be objective, to reduce complex human behavior to extremely simple processes? Such a reduction we find in the description of memory as simple habit actions. Accordingly, we attempt in the following paper to make an objective analysis of memorial behavior without transforming such activity into simple processes easily described but not actually constituting a part of human behavior equipment.

I. THE NATURE OF MEMORY REACTIONS

Memory reactions constitute those delayed or postponed responses to stimuli in which (1) the adjustment stimulus is no longer present when the response is made and consequently must be substituted for; that is to say, a substitute stimulus-object or condition must serve to call out the delayed reaction or response phase of the memory behavior, or (2) the stimulus object itself must again be available after some absence. In the latter case, although the absence may be an exceedingly brief one, we must still look upon the effective stimulus-object as a substitute for the adjustment stimulus which in this instance may be the same object but in a different temporal setting.

More definitely may we characterize memory reactions by referring to them as suspended or continuous reactions. Probably the latter description is much more to the point. The fundamental characteristic of true memory reactions is that they start at some period of time, pass through another time interval which is a less active or suspended stage, and are finally brought to completion in a third and active stage. Or when this last part of the reaction does not occur we have the opposite fact, namely, forgetting. The main emphasis in all cases, however, is on the fact of temporal con-

⁴ "The Method of Absolute Posit," this JOURNAL, Vol. XIV, No. 1, January 4, 1917.

tinuity, although there is a period of indiscernible action in between the two more active phases. The emphasis on the continuity of memory reactions is made, first, because there is a period of apparent non-action before the final phase of the memory act is executed, and secondly, because we are dealing with the actual behavior of a person covering a period of time. Consequently the phases or partial acts might erroneously be considered as being independent discontinuous activities. That a memory behavior segment is a single continuous action no matter how long a time is required for its transpiration is clear when we agree that memory reaction begins at the moment we make an engagement with someone to meet him at a definite time and to end when we actually do meet him at the appointed time and place. That is to say, the memory action goes on from one period to the other.

We find it exceedingly helpful if we study memory reactions as the concrete actual responses of persons. For one thing, it enables us to see how it is possible for a person, who, although he does other things at the same time that he makes an engagement, and also while keeping it as well as in between these two points of time, is no less continuing the identical memory activity throughout the whole series of time periods. Is not the situation very like the case of a person who is going somewhere but who in the same time interval can greet a friend on the way? The hypothesis of the temporal continuity of memory action is rather strengthened than weakened by the analogy between these otherwise very different sorts of behavior when the person can actually stop to chat with his friend.

While we naturally choose for illustrative purposes types of memorial behavior which lend themselves advantageously to the presentation of our conception, we still insist that the case of memory stands no differently when we consider informational reactions rather than grosser sorts of behavior. Here we must be more careful, however, to avoid mere language habits or informational learning, which are quite different sorts of phenomena from memory action, as we will presently point out.

A memory reaction, it follows then, can not be studied and understood unless we consider the action from the standpoint of all of the time periods involved. Of these time periods we may observe the distinct existence of three, namely, (1) the inceptive, (2) the between stage, and (3) the consummatory stage. To these three time units there correspond three phases of a unit action, to wit, (1) the projection or initiatory phase, (2) the middle phase, and (3) the recollective or consummatory phase. The middle phase, be-

cause of its relative invisibility and submerged operation we may practically neglect although it is a genuine phase of all memorial behavior. In general descriptions of memory we disregard the middle phase although it is presupposed in both the projection and recollective phases. Accordingly, the brief examination of each of the two end phases will in our opinion not only reveal evidence that a memorial behavior segment requires for its operation a definite time interval, be it minutes or months, but also that memory consists of a single triphase continuous action.

Whenever we start a memory reaction it is invariably implied that the behavior initiated shall be continued or suspended until some specified posterior time. The immediate act is initiated in order that some related action should occur. We make engagements in order to keep them; we memorize in order to recite after some longer or shorter intervening time interval.

Furthermore, the intervening phase of action which superficially appears as no action whatever must in fact be looked upon as a positive mode of psychological adaptation, since the memorial behavior necessitates this interval between the initiation of the action and its final consummation. A moment's reflection regarding the inhibition of reaction is a convincing argument of the positive actual character of the suspended phase of memorial behavior, and here the consummatory phase of the action is only temporarily inhibited or postponed. After signing the contract the waiting of ninety days to pay the amount nominated in the bond is very much a part of the total memory action involved.

When the final or completion phase of a memory behavior segment operates, its mode of action is conditioned by and implies the functioning of the middle phase. The final action must occur only after a suitable given period which is conditioned by the stimulating circumstances of the entire action. Not only are the two terminal actions incomplete and insignificant unless they are inextricably intercorrelated, but they must also be in the same manner tied up with the middle phases. In fact, while the three phases appear as morphologically distinct they are not so functionally at all.

Another important point for the understanding of memorial behavior and one which argues for the continuity of such reaction is the fact that memory reactions involve very close connections between specific responses and particular stimuli coördinated with them. A given stimulus must call out directly a specific name or a specified act of some non-verbal sort. No substitution of response, no new act not previously begun and postponed may now occur or we are not remembering or are remembering faultily and ineffec-

tively. With respect to directness or connection between stimuli and responses, memorial behavior differs from thinking (another type of delayed behavior) in which the action, when it occurs, may be indefinitely determined by an anterior trial and error procedure.

To the important points which we have just made concerning memory behavior segments, namely, that they operate between two definite end time points, and that throughout this time a particular coördination of stimulus and response is operating, we may now add a third point, namely, that the time through which the continuous action operates may be more or less prolonged. That is to say, even when memory reactions are intentionally projected they may operate finally only after some indefinite time period. This situation is illustrated by the person who is memorizing some material for an examination although he is not fully informed as to when that examination is to take place.

There remains now to point out, that what might appear plausible enough in discussing the continuous or postponing character of memory reactions, when such delayed behavior is taken to be a final reaction (that is, when the memory act is the adjustment or adaptation in question) may equally well be true when the memory act is precurrent to another act. In other words, even when the memory action is only preliminary to some other act, the postponed or continuous functioning is an integral feature of the total behavior situation. This point is really very important for it illuminates greatly the general character of memory behavior. It is well to appreciate the fact that memorial reactions constitute definite types of psychological behavior in the sense that the memory act may be a preliminary recalling of information upon which further action is based or it might itself be the complete adaptation as in reminiscence. In this connection it may be well to point out that, once the second active phase of a behavior segment is operating, the additional problem arises whether there will be a forward-looking result or merely a backward-looking one, that is, one that merely refers back to or repeats the projection stage of memory.

Corresponding to the precurrent and final character of memory reactions are the simple and complex characters of such behavior. Plainly, the precurrent reactions will be by far the simpler of the two types. In fact, the complex final memorial behavior segments may be replete with all sorts of component responses, many of which if functioning alone would be far removed from the description and name of memory behavior.

II. MEMORY BEHAVIOR CONTRASTED WITH OTHER TYPES

The fact that memory reactions are delayed and consequently require substitution stimuli constitute the essential criterion for distinguishing such reactions from, say, perceptual responses. But why contrast memory with perception? We answer, because it has been traditionally held that since in perceptual behavior we react to whole objects although we are in direct contact only with some phase or quality of them, that we must therefore have a memory reaction in each perceptual response. Now we hold that because of the complete absence in perceptual behavior of the continuous and temporally distributed features of memory action that the two are totally unlike.

We assume that the fundamental feature of perceptual responses is the fact that a specific differential reaction is called out by a specific stimulus-object or condition and that any changes in the stimulus-object or in its setting will bring about or result in some corresponding change in the perceptual reaction system. Of course, it is quite true that the reaction now made to a perceptual object is one that was built up in many cases to a whole object, only part of which now calls out the original response, but this in no wise involves any memory response. Tersely put, we do not ordinarily remember that the book we perceive has such and such features on the side we can not now see, although this contact with the book may involve, as in every other perceptual situation, definite memory behavior. That this observation is sound readily appears when we take the case of an orange or other particular object to which we react without ever having been in contact with it before. The act in this illustration is a perceptual act but can not be a memorial action because in the former case we are reacting to an object with a reaction system developed to these qualities (size, shape, color) present among others (taste, weight, texture), *etc.* Whereas in the case of memory the original object is not present at all but is substituted for. Moreover, in the case of memory we have a delayed or postponed reaction. Because memory depends upon a substitute stimulus the reaction is never exactly like a former one and gradually fades. Also, owing to the fact that a number of different absent objects may be reacted to simultaneously, our memory responses may be exceedingly unreliable. When faulty perceptual reactions (illusions) occur they are owing to entirely different conditions, although some imperfect perceptual reactions (hallucinations) may be accounted for on much the same basis.

Two types of facts are implied. therefore, in our conception of memory behavior. In the first place, we have no room in our de-

scription for the sorcerous reinstatement of mental states in the remembering mind through a mysterious association of ideas, a process usually made more mysterious still by means of various forms of imaginary neurology. And in the second place, we abjure the notion that memorial behavior consists of the mere fact of having a reaction system previously acquired, function later whenever the adjustment stimulus is presented. The latter fact is merely a general property or condition of psychological organisms and is the basis for all psychological responses and not merely of memory behavior. This reaction process that we have just been describing is a much simpler fact than that involved in memory and can not possibly be confused with the delayed or postponing of a reaction system. Let us observe then, that memory behavior can not be identified either with habit responses or with learning. For the former are behavior segments constituting closely integrated responses and stimuli; so that the appearance of the stimuli immediately arouses the correlated responses. Indeed, habits as characterized from the standpoint of promptness and immediacy of the total response are almost the opposite in type from memorial behavior.

Now, so far as learning is concerned, besides being merely a coördination of responses and stimuli, such a reaction is presumed to be a more or less permanent acquisition and the more usual condition is that it should be so, whereas memory is in a unique sense a temporal affair designed to operate for a specific period of time only. As a matter of fact, the rather unusual and universally acclaimed incompetent learning known as cramming answers much more to the description of memory than any other kind. Furthermore, whereas learning involves a single coördination between stimuli and responses, memory behavior comprises a special combination of adjustment and substitute stimuli with the given responses. Again, the coördination of learning responses and stimuli are presumed to operate periodically while memory reactions function continuously. We might say further that learning reactions involve much memory behavior and always do comprise some memorial operations, but they are not identical with memory reactions, for learning behavior includes many other kinds of reaction, for example, thinking, reasoning, perceiving, imagining, willing, *etc.*

Incidentally we may here enter a caveat against the assumption that memory responses represent elementary organic processes, very frequently nowadays referred to as mnemonic processes. Besides connecting memory with a very contentless abstraction, this assumption leads us to overlook the tremendously complex conditions which find a place in every memory situation. Almost any memory re-

sponse taken at random will indicate to us a large series of human conditions, adaptational needs and environmental stimuli, all of which in their combination and interaction play a part in the projection and recall phenomena of memory.

III. PROJECTIVE AND RECOLLECTIVE MEMORY

Throughout the whole series of thousands of memory reactions we can trace a functional difference which may be seized upon as a distinguishing mark to divide off memory reactions into two broad types which we will name (1) projective and (2) recollective memory, respectively. The first type is characterized by the fact that its operation depends primarily upon the response side of the stimulus-response coördination; that is to say, the initiation of the act depends to a considerable extent upon the needs and desires or other activities of the person. The second type, on the other hand, depends somewhat more definitely upon the stimulating conditions. Because of some intensity or strikingness of an event in which the person partakes, the memory activity is initiated and operates continuously. The extreme forms of this type of memory are those cases in which, because of a frightful experience, any slightly resembling situation brings to mind sometimes in a shocking manner the original event. Obviously, this distinction must be relative but in practise it is sufficiently observable to provide a criterion.

Another and even more relative distinction between projective and recollective memory may be introduced. We may separate them on the basis of an apparently more prominent operation of the initiatory and consummatory phase of the total behavior. In the one case (projective) the action appears to involve mainly the initiation or projection of a memory behavior, while in the other case (recollective), the important factor seems to be the recalling phase or what is popularly called the recollecting or the remembering. Naturally in each case both phases must be functionally equally present. Since we are dealing with continuous action, the apparent prominence of one or the other phase may be only seemingly a difference, but for purposes of classification at any rate, we accept the distinction as an actual practical difference in the memory behavior types. We proceed, then, to discuss the two types of memory action separately.

(1) *Projective Memory Acts*.—In this class we might consider two types (*a*) the intentional and (*b*) the unintentional projective memory response. (*a*) By intentional projective memory we mean the actions in which the person purposely postpones, suspends or

projects a response into the future to be later performed. As illustrations we might take the situations in which the person makes an engagement, or arranges to do something later, or memorizes some information to be used at a future date.

(b) By unintentional projective memory we refer to situations in which the person is not spontaneously involved in the memorial action; either he is disinterested or does it merely through the influence of a group convention, although the person himself and not the stimuli plays the predominant rôle in the total behavior segment. Typical of such memory reactions are the casual information behavior which involves acquiring memory materials by sheer contact with things.

(2) *Recollective Memory Acts*.—Under the rubric of recollective memory behavior we may include three types, namely, (a) casual remembering or reminiscence, (b) direct recollection, and (c) memorial recovery.

(a) By casual remembering we mean the kind of activity in which some unimportant and even obscure stimulus starts off a train of memory actions to absent things and events. The whole procedure is unconditioned by any need or necessity, but once the process is started it gains momentum and proceeds apace. Each recovered element serves to arouse a further factor. On the whole, the action is passive at the time and no special practical value accrues to the person, although it may be the source of no end of amusement or depressive uneasiness. That is to say, the ongoing of this activity may be of tremendous importance in the way of stimulating the person. So far as the surrounding objects are concerned, however, no change in them need be effected. Again, the whole procedure may be greatly facilitated by the relaxed and inactive condition of the person. We can not at this point refrain from mentioning again that the action represents a consummation of a stimulus and response connection previously organized.

(b) In direct recollection the need to have some information such as a name or event, or when we must recover a lost article, stimulates us to bring about the operation of a consummatory phase of a memory behavior. Here the primary emphasis is upon the recall for the purpose of achieving some practical result, although when the initiatory phase of the action was started there was no emphasis upon the person's participation in the situation. This type of memory is well illustrated by the recollection of a witness in a court trial, though in this particular case the memorial behavior may not result in any apparent direct consequences. The criterion, however, for this kind of memory remains the instrumental recollective one.

(c) Contrasting with the type of memory just discussed, memorial recovery represents the activity in which the consummatory phase of a memory reaction is made to operate primarily for the purpose of the action itself rather than to effect some change in surrounding objects. In memorial recovery the aim is to effect some change of condition in the person, the removal of a weight from one's conscience, as in ritualistic confession or in medical psychoanalysis. It was in connection with this capacity to live over experiences that Aristotle developed his theory of esthetic Catharsis.

IV. INFORMATIONAL AND PERFORMATIVE MEMORY ACTS

Implicit in our distinction of memory behavior just discussed as well as in the rest of our description lies another differentiation which we must bring to the surface. It is, namely, the distinction between memory acts which constitute some actual work to be done (performative) and memorial behavior which merely adapts the person to some past event or action (informational). In the latter case, the person may merely know something about past conditions. In some cases, of course, the information memory reaction may be a preliminary step to a future action dated from the time of the last or consummatory period of the informational memory behavior segment, but in this case we assume the new action to belong to a different behavior segment. The whole distinction which we are making hinges upon the functional character of the behavior segment in which the memorial action plays a part. Thus, memorizing might be considered as a memorial action midway between the informational and performative sort.

To a considerable extent we may use the distinction we have just made as a differentiation between memory in which we are definitely aware of the operation and purpose of the entire act (informational) and cases in which we remember without so definitely employing the memory activity to bring about a necessary or desirable further result (performative). It is only proper to say here that the informational memory may be considered as of the maximum degree of awareness while the performative memory can be so extremely lacking in awareness or intention that it fits the popular term subconscious.

V. HOW MEMORY REACTIONS OPERATE

The operation of memory responses consists primarily of the operation of the two more definitely observable of the three phases described in an earlier part of this paper, to wit, the initiatory and

consummatory stages. The first action initiates or projects delayed or continuous responses, while the second consists of the consummation of the suspended responses through the functioning of a substitute stimulus. This second process consists of the excitation of the delayed response by some stimulus-object or condition which operates in place of the original or adjustment stimulus and which calls out the response to that original stimulus. We may take advantage of this functional division of the memory behavior segment and discuss each phase in turn.

(1) *The Initiatory or Projective Phase.*—In general, this phase consists of connecting up three things, of organizing a tripartite association. This association connects up some act with an adjustment and a substitute stimulus. In different situations one or the other of these features stands out more prominently. For example, in some cases the association of the response with the adjustment stimulus is most prominent. This would be true in all cases where the delayed memory response consists of making an engagement (typical projective response). Again, in other cases the association between the adjustment and substitute stimuli seems to be most prominent as is true whenever we employ a mnemonic system, that is to say, when we remember the days in the month by verse. Here the verse constitutes the substitute stimulus and the days of the month the adjustment stimulus. In still other cases the connection between the response and the substitute stimulus appears most prominent. This is true in case of an engagement in which the response seems to be connected with the day of the week rather than with the person, situation, or event to which we are preparing to adjust ourselves.

This summary statement can obviously be looked upon as the barest sort of outline of the initiation of a continuous or memory reaction. In fact, a fuller content description would necessarily include details concerning the nature of the specific future act involved, besides the description of the exact objects, persons and events serving as the adjustment and substitute stimuli.

The point to the triple association is plain and follows from the general nature of memory action. Because the action is projected and later to be completed when the adjustment stimulus will no longer be present, it is essential that there be connections made between what is to be the consummatory action and other stimuli capable of arousing the action to the adjustment stimulus. But in order that one object or condition should be capable of substituting for another object or condition, it is necessary that the two objects be connected with each other as well as with the projected act. The

entire process of connection spoken of here is merely the ordinary process of psychological association.

(2) *The Consummatory or Recollective Phase.*—The operation of the delayed phase of the memory reaction consists essentially in its arousal by the appearance of the object serving as a substitute stimulus or by the reacting person otherwise coming into contact with a substitute stimulus. In consequence, this contact with the substitute stimulus may be a definitely arranged affair as in the case of employing a memorandum book for the purpose, or it may consist of a very casual contact.

This whole matter of the consummation of a memory act is well illustrated by the fact that forgetting is a direct function of the deliberateness or casualness of the contact of the person with the substitute stimulus. This point may also be illustrated by observing that the possibility of remembering is a function of the number of substitute stimuli connected with the adjustment stimulus. The more substitute stimuli that function in any specific situation the more probable it is that there will be no forgetting, the more probable, in other words, that the memory response will operate.

The reason why a memory response is more likely to occur when there are more substitute stimuli than when there are less is because of the obvious greater possibility for contact between the person and the stimulus. That is to say, the adjustment stimulus is more thoroughly represented. This fact of making possible the operation of the consummatory phase of a memory reaction, or let us say, in short, remembering at all, is usually referred to as retentiveness.¹ The fact that certain information is retained depends upon the number of objects and other facts with which it is connected. For this reason it is generally recognized that the more systematically organized one's knowledge is, that is to say, the more connections made between substitute stimuli and the knowing response, the more capable one is in this kind of situation and the greater facility one has in the employment of such information.

We might emphasize here that this factor of retentiveness is decidedly a matter of associational connection and thus is justified the traditional belief that memorial behavior is to the largest extent a fact of association. More important it is, however, to observe that the associational process is at every point a thoroughly and completely objective series of happenings. Memorial behavior, we re-

¹ The writer here wishes to pay a just tribute to the whole line of psychologists who have observed the serial (three or four members) functioning of a memory behavior segment, although they do not emphasize the functional continuity of the members, nor describe them in an objective manner.

peat, is without doubt a matter of associational connection, even if it is true that in some cases as in cramming or the remembering of a thing but for a brief period, only a very limited number of retention substitute stimuli exist and operate.

In the operation of memory behavior segments a series of specific forms of operation may be observed to occur. These forms may involve primarily either the stimulus or the response and may be described as follows.

(a) *Stimulus Forms*

(1) *Some Object or Event Operates throughout the Whole Behavior Segment.*—Here the substitution and adjustment stimuli are both the same object, that is, I remember to react to some object because I now see it or remember to tell some person something I agreed to tell him because his presence itself reminds me of the fact. Probably this form of memory action would be most common in the segments which we have agreed to name the recollective reactions.

(2) *Another Object Becomes the Adequate Stimulus.*—In these segments a different object from the one to which the response is to be made initiates the consummatory phase of the response. This form of memory may safely be called the typical sort and it undoubtedly constitutes a larger series of actual memory behavior segments. Moreover, the reactions of this type constitute the most effective of our memory behavior. Because of the range of objects that can serve to arouse the reaction the memory behavior can be carried over great stretches of time and place. A striking example of the power of such memory actions as we are now discussing is supplied us in the operation of the extremely complex behavior in which we use printed and other symbolic records to incite memory reactions to function.

(b) *Reaction Forms*

(1) *Same Reaction System.*—Many of our memory reactions operate through a postdated functioning of the same reaction system or response pattern. This reaction system or pattern is the original projected action which is connected with a specific stimulus, whether it be the same or a different object. Illustrative of this form of memory reaction is the recalling of a name, a date or any type of information. The effectiveness of the reaction depends entirely upon the literalness with which the original projected act operates after its period of actual delay. Possibly this type of

reaction does not comprise the most important of our memory reactions, since we include here the whole series of rote memory responses.

(2) *Different or Partially Different Reaction Systems.*—A great number of our memory reactions do not involve necessarily a simple exact repetition of a specific reaction system. Rather a more or less greater freedom is allowed us in the action. This fact arises from the circumstance that these types of memory behavior represent adaptation to cultural conditions or objects and not to specific physical objects. Nor are these reactions very definite direct adaptations, such as going to a certain place at a given time; instead they involve situations in which a novel or constructive action carries out the purpose of the situation. The projection and later carrying out of a scientific investigation, the execution of a literary or other artistic commission, in so far as they involve a projection and a later operation of a memory reaction, all illustrate the extreme forms of memory reactions of the present class. From these more complex substitutable responses we may trace out a descending series which may run down to substituted reactions differing very little in morphological character from the action operating at the time the memory behavior is in the projection stage.

VI. RECOGNITION AND MEMORY

Psychologists have always recognized that memorial behavior essentially and intimately involves recognition. The relationship is indeed a close one although recognition is not exclusively a feature of memory. Perceptual reactions are no less closely connected with recognition behavior. That recognition reactions, however, have historically been presumed as most closely connected with memory is accounted for, we believe, by the fact that in complex memorial behavior recognition assuredly occupies a very strategic and prominent position. Unless we are to leave our description of memory in too fragmentary a form we must then indicate the exact operation of the recognition function in memory.

But first let us point out why recognition appears to be so prominent a factor in such behavior. Both the clue and solution are found in the continuous and prolonged character of memory reactions. In other words, there must be some marks or signs of connection of the second phase with the first. The point is, that the second phase, although an integral part of the memorial behavior segment, may still be detached in whole or part from the first phase of action. Now aside from the essential or universal fact that the two phases must occur in order that a memory act shall be completed, it is

frequently necessary that the person performing the action should appreciate overtly the connection between the two phases. How frequently it is necessary for this overt appreciation of the continuity of the memory behavior to occur depends upon the general overtness of the memory action. That is to say, whenever the person is fully aware of the need for an operation of the memorial reaction, then the recognition factor is essential. Incidentally there issues forth here two related points that must be at least briefly inspected. In the first place, not all memorial behavior requires a recognition factor; only the more elaborate sorts of memory do so. And in the second place, the recognition feature may be of different degrees. It remains now for us to describe briefly the process of recognition and to indicate how it varies in its operation.

Recognition in general is a meaning reaction; that is to say, the final action to a stimulus is preceded by a determining action which lends color and direction to the succedent or final act. Because a memory action involves a minimum of two operations (projection or consummatory) and also two stimuli (adjustmental and substitute) the stage is well set for the performance of recognition action. To illustrate with the simplest case, when the substitute stimulus appears there may occur a single direct response to the adjustment stimulus; here we have memory without recognition. But if in this behavior segment some implicit or overt response precedes either necessarily or fortuitously the reaction to the adjustment stimulus, why then we assume that the individual recognizes either the reaction or to what the reaction is made. In other words, the substitution stimulus-object becomes a sign for whatever thing we presume to be signified (act or adjustment object). As in every other case of meaning behavior the recognition factors or reaction systems are to a considerable extent, though of course not exclusively, implicit responses and verbal reactions, and possibly the latter are most characteristic in memory behavior. Very familiar is the functioning of exclamatory reactions in memorial recognition, "I see" being a most frequent meaning reaction, although none the less potent are subvocal language responses.

Besides the appreciation by the person that the stimulus-object initiating the memory behavior, and the stimulus-object (substitution) operating in the culmination of the act are related to each other and to the act, there are still other factors involved in the more complex forms of recognition. In addition to those enumerated features, the individual may also realize his own place in the total memory situation. To be explicit, the person himself becomes an additional stimulus, or more frequently assumes the function

of the setting of one or more of the stimuli involved. The most complex form of recognition is the case in which the individual continues to project himself into every feature of the continuous memory response. It is in such cases as these that the person's own responses constitute a good share of the memory behavior and condition directly the continuity features of such behavior.

Now we might point out that in the complex recognition memory reactions the person may not only play a part in the total behavior when the recollective phase operates, but may also play such a part in the initiatory phase. Instead of the person appreciating that the response has in fact been continued, has reached culmination and that the final response has answered the purpose, he may likewise appreciate the necessity for and the actual occurrence of a projection act. Recognition of the nature and needs of projecting a response to be later consummated depends, of course, upon previous experiences with similar situations.

VII. THE STIMULI FOR MEMORY REACTIONS

In descriptions of memory behavior the specifications of stimuli and stimulation conditions appear to be of more significance than in other types of action, although stimuli are of necessity integral factors in all psychological acts. In the first place, because memorial retention consists of the interconnection of responses with adjustment and substitute stimuli, the stimuli are more uniquely phases of the total behavior situation. In the second place, since memorial behavior comprises two phases operating at different times, the stimuli features of such reactions loom large. And finally, memorial reactions are responses of occasion; so that combinations of responses function together and for that reason the stimuli obtrude themselves upon the student who attempts to analyze such behavior. To illustrate, when taking an examination the fact that we are undergoing examination is in general a stimulus for memorial behavior, while the specific ideas or facts recalled are brought out by the particular questions which we may call the substitute stimuli for the objects and events around which the examination is centered.

In general, then, we find the stimuli factors exceedingly conspicuous in descriptions of memorial behavior. We may proceed now to point out some of the more prominent forms of memorial stimuli and we might, because of the prominence of the recollective phase in memorial behavior, put the problem into the following form. What kind of objects and conditions can serve as substitute stimuli?

Among such stimuli we find of course objects and events. Any object or event connected with some other object or event to which we respond without its being present may now serve to arouse a response to that non-present object.² The same thing is true of the setting of an object or event. A time, place or object setting may serve as a substitute stimulus to induce a reaction to some adjustment stimulus-object which was at some previous time connected with that setting. Very instructive is the observation here that a thing may serve as a substitute stimulus for itself, as in the case of some object stimulating a recollection of some past experience with it.

Again persons constitute a large part of our memorial stimuli. This is true for several reasons; first, a large part of our behavior in general involves contacts with persons and in consequence the latter may substitute for each other as memorial stimuli. Moreover, because much of our memorial activity consists of informational reactions the stimuli thereto consist of language activities of persons. Besides the language reactions of other persons, one's own language responses are a potent source of memory behavior. Nor do the language acts exhaust the list of substitute stimuli, since our observation reveals numerous other of our reactions that serve in similar capacities.

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BOOK REVIEWS

Dodi Ve-Nechdi (Uncle and Nephew) the work of Berachya Hanakdan. Edited from MSS. at Munich and Oxford, with an English translation, introduction, etc.; also English translation from the Latin of Adelard of Bath's *Quæstiones Naturales*. HERMANN GOLLANCZ. Oxford University Press, 1920. Pp. xxii + 220.

Berachya Hanakdan—a Jewish scholar of the thirteenth century—was lost track of by the historians even though he seems to have played a prominent rôle in medieval literature. The Fox Fables were his only printed work before 1902, when Professor Gollancz edited and translated some of his manuscripts and entitled them *Ethical Treatises*. These treatises, though regarded by Gol-

² At this point we find in the actual operation of psychological facts a justification of Dewey's contention that knowledge involves a continuity of objects and events. Cf. Dewey's "Realism without Monism or Dualism," this JOURNAL, XIX, pp. 309, 351.